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## **Experimental Study of the Biocompatibility of a New Glass-Ionomer Root Canal Sealer (Ketac-Endo)**

*Kolokuris I, Panagiotis B, Economides N, Vlemmas I. Experimental Study of the Biocompatibility of a New Glass-Ionomer Root Canal Sealer (Ketac-Endo). J Endodon 1996;22:395-8.*

**Purpose:** To study the comparative biocompatibility between Ketac-Endo and a well-known sealer, such as Tubli-Seal.

**M&M:** Sterile Teflon tubes were filled with either Ketac-Endo or Tubli-Seal, & implanted in the backs of rats. Samples were recovered at 5, 15, 60, & 120 days. They were then fixed, stained & studied microscopically for types of inflammatory cells, location & type of fibrous tissue, & any vascular changes.

**Results:** The specimens with Tubli-Seal had severe inflammation with necrosis on the 5th day, with this reaction remaining severe at the 15th day. On the 60th day, giant cells with particles of material could be seen, but the inflammatory reaction had diminished. By the 120th day, the inflammatory reaction was mild, with some macrophages in the tissue with particles of material in them. The Ketac-Endo specimens had mild inflammatory reactions on the 5th day, with plasma cells, lymphocytes and macrophages. The reaction decreased by the 15th day, with plasma cells being rare. Reduction continued through the 60th day, and by the 120th day, the tissue was almost normal.

**C&C:** A reaction that causes necrosis & severe inflammation would not be desirable in this day of sealer puffs. Post operative discomfort could potentially be decreased with the use of Ketac-Endo. The authors note that it now has a longer working time, and a better flowing consistency.

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**Robin E. Hinrichs**

## **pH changes at the surface of root dentin when using root canal sealers containing calcium hydroxide**

*Esberard RM, Carnes Jr. DL, del Rio CE. pH changes at the surface of root dentin when using root canal sealers containing calcium hydroxide. J Endodon 1996;22:399-405.*

**PURPOSE:** To investigate long-term pH changes in cavities prepared in root surface dentin of extracted teeth after obturation of the root canal with gutta-percha and a variety of calcium hydroxide sealers.

**M&M:** Fifty extracted human permanent teeth with single root canals were cleaned and shaped to a minimum size #40 Flexofile. The canals were flushed with EDTA solution to remove the smear layer at the termination of the instrumentation. Two cavities were drilled in the facial surface of each root (one in the center of the cervical region and one in the center of the middle region) and cleansed with EDTA to remove the smear layer. The 50 teeth were separated into 5 different groups. Teeth in the experimental groups were obturated with gutta-percha and one of the following root canal sealers: Sealapex, Sealer 26, Apexit, and CRCS cement. The fifth group served as the control and was not obturated or treated with sealer. The pH was measured in the prepared cavities at 0, 3, 7, 14, 21, 28, 45, 60, 90, and 120 days after obturation by placing 2 µl of distilled water in the preparations for 10 minutes and obtaining measurements with a calibrated microelectrode.

**RESULTS:** The results of the study indicate that the pH at the surface of the root does not become alkaline when calcium hydroxide cements are used as root canal sealers. The observed pattern of pH change was not different from that seen in the control group of roots that were not treated with sealer over the 120-day duration, whether pH measurements were made in the cervical or middle regions of the root surface. Surface pH in all groups at the beginning of the experiment ranged between pH 7.0 and 7.6, peaking at pH 8.0 by 3 days. By 28 days, pH values had decreased to pH 6.5 to 6.8, wherein they remained for the duration of the experiment.

**C&C:** It's interesting to note that, if anything, the pH became more *acidic* with time, rather than more alkaline. No explanation was given for this observed phenomenon. Had this experiment shown that the pH did indeed become more alkaline with time, indicating diffusion of hydroxyl ions, I would have been concerned with what effect this diffusion process would have had on the integrity of the sealer over time.

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**Orest M. Harkacz, Sr.**

## Changes in pH at the Dentin Surface in Roots Obturated with Calcium Hydroxide Pastes

*Esberard RE, Carnes DL, del Rio CE. Changes in pH at the Dentin Surface in Roots Obturated with Calcium Hydroxide Pastes. J Endodon 1996;22:402-5.*

**Purpose:** To ascertain whether or not any CaOH paste was superior to the other, with respect to the release of hydroxyl ions, and to clarify whether or not pH at the root surface varied with respect to anatomical regions.

**M&M:** The M&M was similar to the previous article. The teeth were obturated with aqueous calcium hydroxide past, CaOH paste with CMCP, Pulpdent paste, or no CaOH (control). pH was measured as in the previous article.

**Results:** There was an initial increase in pH in all three regions, which the authors attribute to the diffusion of sodium hypochlorite irrigating solution. The pH produced by CaOH in CMCP produced the highest pH of all the pastes at every time period. At day 3 it was 10.6, and at day 14 was 10.3. The Pulpdent and Aqueous CaOH produce similar changes in the pH, but not as high. In general, there was a rapid rise in pH from control values by day 3 in all groups, followed by a decline to pH 9.0 over the next 18 days, before finally rising and remaining near pH 10.0 for 120 days. In the apical region, the elevated pH produced by Pulpdent or aqueous CaOH occurred over a much longer period - 40 days, than in the middle & cervical region.

**C&C:** The increased pH for longer periods at the apical region may indicate that the hydroxyl ion diffuses more quickly in the middle & cervical regions, possibly due to the increased number & diameter of the dentin tubules. The authors also note that the alkaline environment may interfere with the resorptive activity of dentinoclasts, which require an acid environment. They suggest postponing root canal obturation of avulsed teeth for 7 - 14 days after replantation to allow the PDL tissues to heal. The increased alkalinity of the environment at the root surface may play a role in decreasing external inflammatory resorption.

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## **Canal transportation caused by a new instrumentation technique and three standard techniques**

*Marroquin BB, Pistorius A, Willershausen-Zönnchen B. Canal transportation caused by a new instrumentation technique and three standard techniques. J Endodon 1996;22:406-9.*

**PURPOSE:** To investigate the benefits of a new root canal preparation system, comparing its transportation characteristics with those of three different enlarging methods in a theoretical ideally prepared canal by means of a computer-supported device.

**M&M:** Manufactured root canals embedded in clear casting resins were used to demonstrate the transportation effects of four different enlarging methods (balanced force concept, step-back, recapitulation, and a prototype system previously described by Marroquin). The preparations were compared, in vitro, with a theoretical ideally prepared root canal in their ability to maintain the original canal path during root canal preparation. A computer- supported enlarging device and double exposure photography method described in a previous study by Briseño was used for evaluation of the resulting canal preparations. Measurements of the amount of material removed from the simulated canals were made at the concave and convex sides of the canal at four different levels (1, 3, 5, and 7 mm) from the apical foramen.

**RESULTS:** No enlarging technique proved to be able to prepare canals ideally. The prototype system remained closer to the ideal dimensions at almost all measuring levels and points.

**C&C:** Although the authors state that the prototype technique remained closer to the ideal dimensions at most measuring levels, the table showing a summary of the significant differences between ideal and respective preparation methods at the different measuring levels and points does not support this statement. Also, the prototype technique utilizes preflaring as part of the preparation. The use of preflaring was not mentioned for the balanced force concept, step-back technique or recapitulation technique, which could affect the results of the experiment.

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## **A Comparison of Curved Canal Instrumentation Using Nickel-Titanium or Stainless Steel Files with the Balanced-Force Technique**

*Harlan AL, Nicholls JJ, Steiner JC. A Comparison of Curved Canal Instrumentation Using Nickel-Titanium or Stainless Steel Files with the Balanced-Force Technique. J Endodon 1996;22:410-3.*

**Purpose:** To compare Onyx-R & Flex-R files with respect to canal movement in curved canals.

**M&M:** The Bramante technique was used to compare 2 groups of teeth, one instrumented with stainless steel Flex-R's, and the other instrumented with nickel-titanium Onyx-R's. Computerized pre- and post-instrumentation images were used to calculate the differences in canal centers and area in the apical and coronal areas.

**Results:** In the coronal sections, the Flex-R's had significantly more canal center movement than the Onyx-R instruments. The average difference was only 0.041 mm however. In the apical section, there were no significant differences in canal center movement. The apical & coronal post-instrumentation areas of both instruments were not significantly different. There was no significant correlation between either true angle of curvature versus canal center movement or true angle of curvature versus post-instrumentation area in either the apical or coronal sections.

**C&C:** This seems to counter the thought that the Onyx-R's are not as efficient as Flex-R's due to their increased flexibility. The fact that there was no difference in post-instrumentation area shows them to be equally efficient. However, the authors do not mention if they took any longer to instrument with, or of any difficulties they might have encountered. The increased flexibility of the Ni-Ti files may actually help reduce the incidence of stripping mid-root and apically due to their increased flexibility.

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## Neurogenic inflammation and tooth pulp innervation pattern in sympathectomized rats

*Komorowski RC, Torneck CD, Hu JW. Neurogenic inflammation and tooth pulp innervation pattern in sympathectomized rats. J Endodon 1996;22:414-17.*

**PURPOSE:** (1) To investigate the possible collateral C-fiber innervation pattern between rat molars using a neurogenic-mediated inflammation pattern, and (2) to examine what effects if any sympathetic efferents have on neurogenic inflammation in the rat molar pulp.

**M&M:** Mustard oil was applied to the pulp of the left mandibular first molar in two groups of rats: group 1 (n=8), which consisted of guanethidine sulfate sympathectomized rats (to dismiss sympathetic activation by the mustard oil); and group 2 (n=8), which consisted of unsympathectomized rats. In group 3 (n=6), normal unsympathectomized animals were treated using the same protocol, except normal saline was applied to the pulp as a mustard oil control. Evan's Blue dye was administered by IV 30 minutes after application of the mustard oil or saline. After 15 minutes, the lower jaws were dissected and all the lower molar and incisor teeth were extracted, cracked open to expose the pulps, and incubated in formamide to extract the dye. The samples were analyzed spectrophotometrically. The left and right superior cervical ganglia were dissected, fixed and examined qualitatively to determine the effectiveness of the chemical sympathectomy.

**RESULTS:** Evan's Blue concentration in the teeth were expressed as a ratio of the relative concentration present in a left tooth compared with that of the corresponding tooth on the contralateral side. No difference in the Evan's Blue ratios were noted between the first, second, and third molars and incisor teeth in the control group (group 3). Ratios were significantly higher in the first, second, and third molars of sympathectomized rats receiving mustard oil (group 1) than in corresponding teeth in normal rats receiving saline (group 3). No difference in Evan's Blue ratios was noted in the first and second molars between groups 1 and 2. In serial histologic sections, the unsympathectomized rats showed a normal histologic architecture of the superior cervical ganglia. The guanethidine-treated rat sections consistently displayed a loss of neuronal cell bodies and vacuolization in the ganglia.

**C&C:** Neurogenic inflammation is characterized by an antidromic reflex (conducting impulses in a direction opposite to the normal), whereby unmyelinated sensory C-type fibers release inflammatory-modulating neuropeptides when stimulated. These neuropeptides (which include CGRP and substance P) can give rise to antidromic vasodilation and plasma protein extravasation. In this study, Evan's Blue bound to extravasated plasma proteins. Since the ratios of the dye were higher in the sympathectomized, mustard oil treated rats (group 1) than in the corresponding teeth in saline treated rats (group 3), this indicated that plasma protein extravasation was occurring in the pulps of the molars of group 1. Since mustard oil was applied to one molar only in the quadrant, this suggests that the oil applied to the one molar can be responsible for the neurogenic inflammation observed in the pulps of neighboring teeth, offering evidence that collateral C-fiber innervation may exist between rat molars within the same quadrant. Sympathetic activation was dismissed in group 1 by application of guanethidine. Since no difference was observed in Evan's Blue ratios between groups 1 (sympathectomized) and 2 (unsympathectomized) molars, this indicates that sympathetic efferents have no effect on the degree of mustard oil induced neurogenic inflammation. C-fiber collateral innervation did not extend to the incisor. The conclusion arrived from the experiment was that *collateral C-fiber afferent innervation seems to exist between the pulps of the mandibular molars of the rat. This collateral innervation does not include the incisors, and sympathetic efferents have no modulatory effect of neurogenic inflammation mediated plasma extravasation in the pulp of the rat molar.*

## Periapical Lesions in Rats with Streptozotocin-induced Diabetes

*Kohsaka T, Kumazawa M, Yamasaki M, Nakamura H. Periapical Lesions in Rats with Streptozotocin-induced Diabetes. J Endodon 1996;22:418-21.*

**Purpose:** To investigate the periapical tissue histologically after pulpal exposure in streptozotocin-induced diabetic rats.

**M&M:** 40 rats were injected with citrate buffer (group A) or streptozotocin in citrate buffer (group B). Glucose levels were measured at day 0, 7, 14, 28, & 42 days. Three days after the injection, their man 1st molar pulps were exposed and left open. Rats were killed at 7, 14, 28, and 42 days. Five histological sections were made of each, & the PDL surface area was measured.

**Results:** Groups A rats weighed significantly more, and had blood glucose levels of approximately 100 mg/dl throughout the study. Group B rats averaged a level of 331 - 455 mg/dl. Overall, in both groups they observed moderate pulp inflammation at day 7, severe inflammation & more pronounced alveolar resorption at day 14, necrotic pulp and periapical abscess formation at day 28, and severe apical inflammation and fibrous tissue formation and root resorption at day 42. All the reactions were more pronounced in the diabetic group. Histometrically, vertical length, horizontal length, and area of periapical PDL in the diabetic group were significantly larger.

**C&C:** The lack of glucose utilization causes cellular starvation, and the hyperglycemia leads to increased urine output and metabolic acidosis. The neutrophils exhibit decreased phagocytosis, diapedesis, decreased adherence, and impaired chemotaxis. The body is not as able to respond to an infection. Perhaps these patients are more susceptible to periapical disease and its sequelae as they are to periodontal disease.

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## **A comparison of pulpectomy alone versus pulpectomy with trephination for the relief of pain**

*Moos HL, Bramwell JD, Roahen JO. A comparison of pulpectomy alone versus pulpectomy with trephination for the relief of pain. J Endodon 1996;22:422-25.*

**PURPOSE:** To determine if there is a difference in postoperative pain relief in patients presenting with acute periradicular pain of pulpal origin when treated by either pulpectomy alone or pulpectomy with trephination.

**M&M:** Seventeen patients with pretreatment pain and a clinical diagnosis of acute periradicular periodontitis or chronic periradicular periodontitis with symptoms were studied. Eleven patients (the control) received a pulpectomy to the radiographically determined working length. Six patients received a pulpectomy and trephination using a #4 round bur through a vertical incision (the experimental group). Visual analog scales were used preoperatively to measure pain intensity and unpleasantness, and postoperatively to measure intensity, unpleasantness, and pain relief at 4, 8, 16, 24, 48, 72, and 96 hours.

**RESULTS:** Analysis of preoperative data showed no difference between control and experimental groups. Posttreatment, at 4 hours, the trephination group reported significantly more pain intensity and unpleasantness and less pain relief than the control group. Pulpectomy alone provided significantly better postoperative pain relief at 4 hours compared with pulpectomy with trephination. At no time interval did the trephination group have less pain than the group without trephination.

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## **Repair of Incomplete Vertical Root Fractures in Endodontically Treated Teeth - In Vivo Trials**

*Selden HS. Repair of Incomplete Vertical Root Fractures in Endodontically Treated Teeth - In Vivo Trials. J Endodon 1996;22:426-9.*

**Purpose:** To evaluate the healing of a new approach to the repair of incomplete vertical root fractures (IVRF).

**M&M:** Six patients diagnosed with IVRF agreed to the experimental procedures. After surgical exposure, to provide access and visualization, an ultrasonic microendo tip was used to excavate the IVRF to a depth of 2 - 3 mm, with a width of ~ 1 mm. The defect was bonded with 4-META, then packed with Ketac silver cement. Resorbable hydroxylapatite was placed over the repaired root, beneath a Gore-Tex barrier membrane. The barrier was removed 6 wks later. This procedure was done on three patients. Two roots had the same techniques, but the fracture was acid-etched with phosphoric acid and filled with Ketac-no silver cement. One root had the same basic technique, but no bone graft or GTR was used.

**Results:** Success was determined by a lack of adjacent periodontal pocket, no pathological radiographic findings, and no patient report of discomfort. Of the 6 roots, 5 failed within 2 - 11 months. One root remained symptom free, without periodontal pocket formation for 1 yr., but then failed because the IVRF became a split root. One of the failures had an initial fistula, and another had a split root at the time of surgery.

**C &C:** The technique is interesting in that the one root that received no GTR or bone graft had no hope of acquiring a new attachment apparatus. Four of these teeth were all part of fixed partial dentures, and were under a great deal of occlusal stress. There are multiple etiological factors to be considered when attempting to treat an incomplete vertical root fracture.

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